



ASES UPDATE

Advanced Speed Enforcement System

Project Update-March 2003



GOAL: Enhance Safety

- Eliminate human error by stopping train before stop required
- Provide as soon as possible
- Use proven technology



ASES

- Integrates “proven” ATC and SES technologies.
- Can be incrementally installed-builds on existing wayside investment.
- Gives maximum safety benefits.
- Needs no satellite or radio infrastructure or on-board database.
- Has *not* been done before.



ASES Functionality

- Replace/update/expand existing on-board ATC.
- Function as system speedometer.
- Efficiently display speed authorities (SDU).
- Provide speed authority enforcement
 - ✦ Positive stop-signal
 - ✦ civil (fixed)
 - ✦ signal (variable)
 - ✦ temporary restrictions
- Recurring acknowledge (55-sec./restricting)



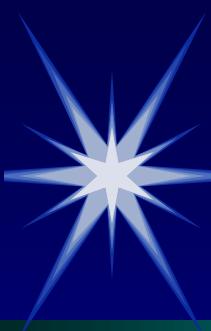
ASES Functionality (cont'd)

- Automatic freight/passenger characteristics.
- Roll-away protection.
- Automatic self-test.
- Solid-state/microprocessor reliability.
- Software-based; allows for future functionality/enhancements/interfaces.
- Minimal additional wayside infrastructure.
- Integrated FRA/System event recorder.



ASES Functionality (cont'd)

- Seamlessly operates over various territories.
 - ✦ Non-equipped
 - ✦ Cab signal/ATC only (includes 9-aspect HDIS)
 - ✦ SES-only (existing wayside signal overlay) and against the current of traffic in NORAC rule 251 ABS.
 - ✦ Combined ASES
 - ✦ AMTRAK ACSES
 - ✦ “Unknown”
 - ✦ Installation area



Automatic Train Control (ATC) Functions

- Provides continuous in-cab speed commands (for signal aspects).
- Ensures response to signal downgrade/overspeed.
- Required for operation on AMTRAK NEC.
- Uses rails as transmission medium
 - 100/250 Hz High-level carrier
 - Uses standard code rates.



Speed Enforcement System (SES) Functions

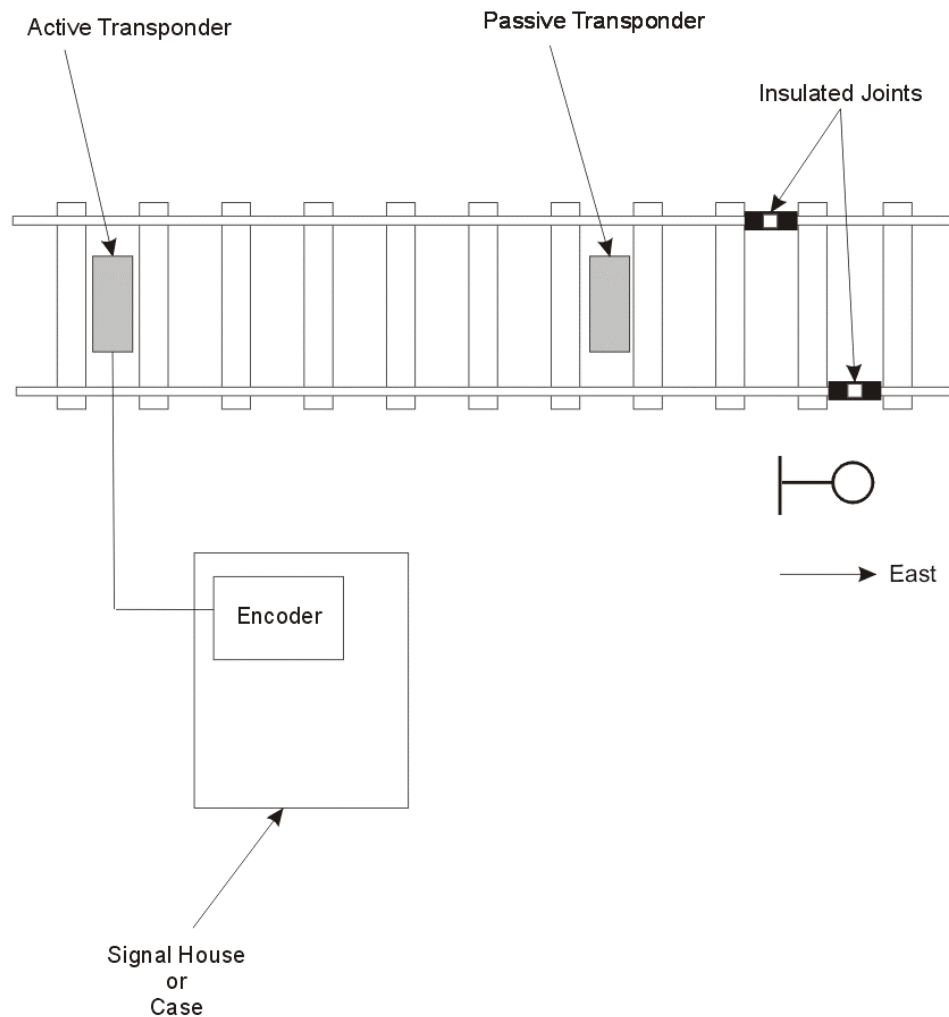
- Transponders at wayside signal locations programmed with fixed & variable (aspect/route) information.
 - position tracking based on transponder location input and tachometer inputs
 - Profile speed enforcement
 - Economical enforcement of civil speeds
 - Permanent (bridges, curves, etc.)
 - Temporary (work areas)
- Positive Stop
 - Home Signal displaying Stop or Restricted-Unique Pass Stop Codes
 - First Automatic Signal displaying Stop & Proceed
 - SES requests Train Stop Penalty at subsequent Automatic Signal displaying Stop & Proceed if the Locomotive Engineer fails to stop prior to the signal.



Transponder Types

- Passive transponder
 - ✦ a stand-alone device
 - ✦ always transmits its *resident* telegram to train
- Active transponder
 - ✦ Connected to an encoder that supplies telegrams that correspond to different input conditions (signal aspects)
 - ✦ Contains a resident, or default, telegram transmitted if the encoder or associated component, such as the connecting cable, fails.

Transponder Group





Transponder Data

- Transponder positioning & linking
- Configuration of transponder group
- Territory
- LoA (signal aspect & type, gradient, target speed & type, distance to target & increase, route)
- Civil restrictions
- Installation area identification



Transponder Operation

- On-board antenna generates 27 MHz field
 - ✦ Induces current in transponder to power electronics
 - ✦ AM supplies 50K b/s clock signal
- Data bits clocked from memory to form telegram
- Each “1” bit pulses a resonant uplink antenna circuit that generates 4.5 MHz signal



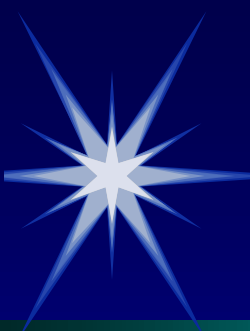
Transponder Telegram

- Telegram format: 255 bits in BCH code
 - ✦ 180 user bits
 - ✦ 64 bits BCH CRC
 - ✦ 8 bits for synchronization
 - ✦ 1 bit for inversion protection
 - ✦ 2 bits to give CRC a mix of 1s & 0s
- Code is cyclical
 - ✦ any 255 bits can be checked
 - ✦ No waiting for verification, only data



Transponder Bit Assignments

- Coordinated with Alstom for ACSES
- Preserve future undefined functionality
- Allow distinguishing among train types
- Unique identification of location
- Duplication within group of certain information
- Up to 4 transponders in group



Territories

- **Unknown:** provides control at start up (cab keyed on), power reset, and predefined system exit areas; enforces a 10 mph speed limit
- **Non-equipped:** supervises 79 MPH MAS
- **Cab signal:** Enforces speed limits associated with 9 valid 100/250 Hz codes transmitted through rails
- **SES-only:** enforces wayside signal, civil restrictions, and territory type status from active & passive transponders at all signal locations



Territories (cont'd)

- **Combined:** active transponders at distant and home signals; passive transponders at all signal locations provide positioning information for distance tracking, fixed civil restrictions, and territory type data. Cab signal code inputs used in conjunction with transponder information to provide *continuous* speed enforcement.
- **Installation Area:** defined speed enforced within a defined maximum distance. All other information ignored (Cab & SES). Avoids need to cut system out during construction.



ASES Implementation

- **Vehicle installation off-site**
 - Functional testing/calibration
 - New operating rules required
 - System familiarization:
 - ◆ Test trains
 - ◆ SDU
 - ◆ Train crews require hands-on training
 - ◆ Field forces require installation/troubleshooting training
- **Wayside installation in stages**
- **Temporary freight train operational waiver**
- **Software versions (ACSES volatility, problem resolution)**



ASES Delay Issues

- FCC license (Temporary, Petition for Permanent new rules with HSRC, Retest & Resubmit)
- Integration of SES with ATC
 - ✦ Limited on-board “real estate”
 - ✦ Additional functionality for operation in *all* territories
 - ✦ Modeling
 - ✦ New Hardware & Software Simulator
- New Graphical SDU flat panel display
- Precision of ROW information
- AMTRAK ACSES Compatibility
- Software & Hardware Verification and Validation
- FRA recorder integration
- Custom requirements of individual vehicles (vs. trains)



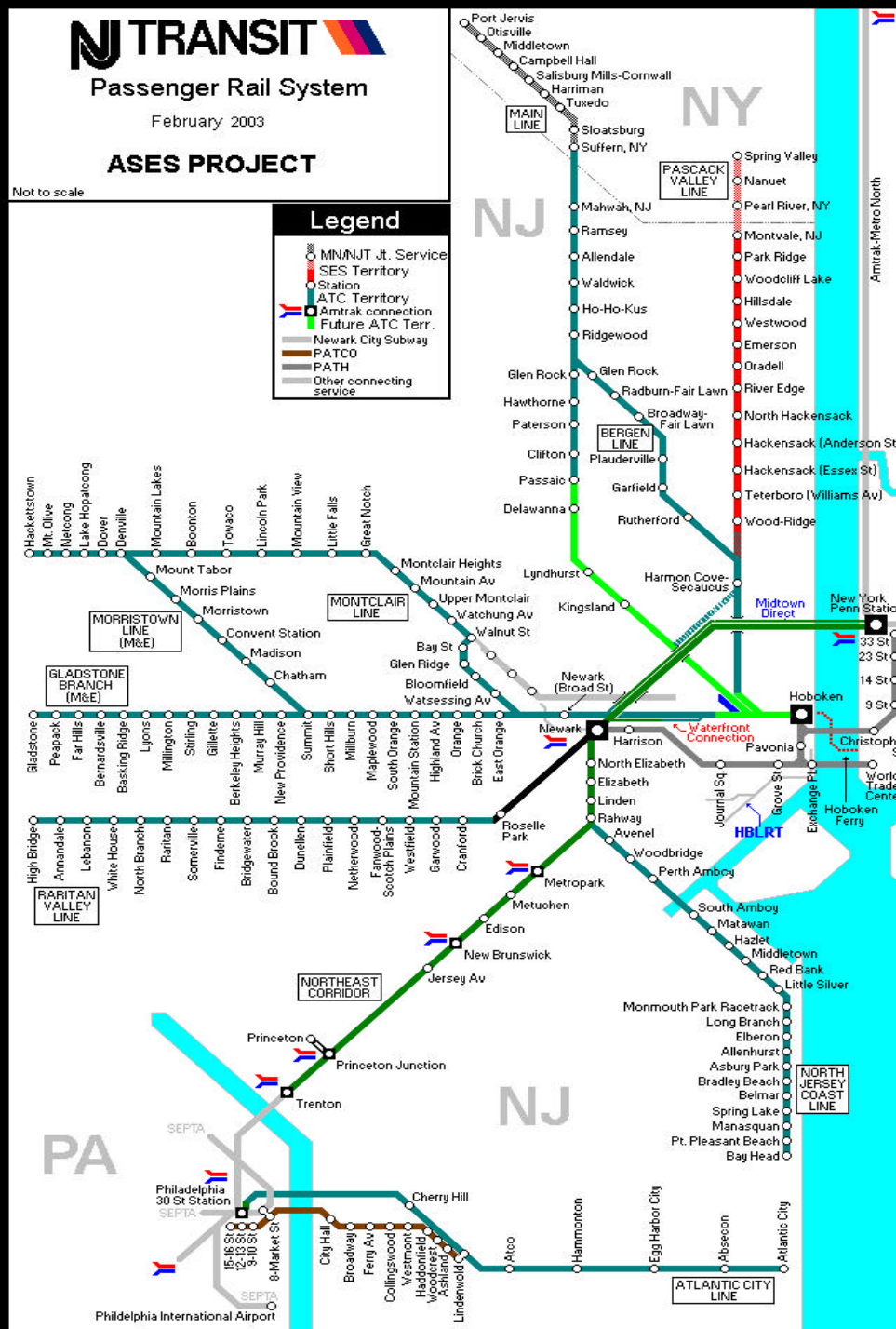
CURRENT Contract

- Phase I – Demo
- Phase II –
 - ✦ Install SES only on Pascack Valley Line
 - ✦ Design Main Line
 - ✦ Install ASES on trains for NEC HDIS operation
- Phase III – Install ASES on remainder of
system

Not to scale

Legend

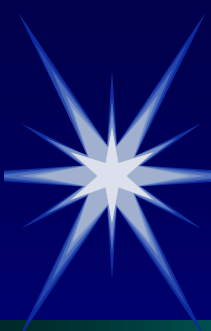
- MN/JNJ T. Service
- SES Territory
- Station
- ATC Territory
- Amtrak connection
- Future ATC Terr.
- Newark City Subway
- PATCO
- PATH
- Other connecting service





NJT Project Status

- SES in revenue service on Pascack Valley Line
 - 13 trains (GP40s and COMET1 Cab Cars)
 - 20 trips a day
 - 23 miles of SES-equipped single track
 - No Cab Signals
 - Active transponders installed at all Signal locations
 - 97 Transponders & 33 Encoders
- SES providing stand-alone car-borne ATP
 - Signal enforcement
 - Positive stop
 - Line Speed
 - Civil Speed



NJT ASES Onboard Status

- SES Installed (not counting PVL equipment):
 - 85 Arrow-III EMU Married Pairs
 - 7 Arrow-III EMU Singles
- Additional Installations:
 - 15 Arrow-III EMU Married Pairs
 - 23 Arrow-III EMU Singles
 - 32 ALP-44 Electric Locos
 - 74 Diesel-Electric Locos
 - 45 Comet Push-Pull Cab cars
- Being installed on all new vehicles:
 - 30 ALP-46 Electric Locos
 - 33 Diesel-Electric Locos
 - 16 Comet-2 Rebuilds
 - 50 Comet-5 Push-Pull Cab Cars



ASES Project Wayside Status

- Wayside SES design for Mainline 100% complete
 - 32 track miles (15 miles of double/triple track)
 - 192 Transponders & 40 Encoders
 - To be placed in revenue service when vehicles available
- Cab Signal installation on all lines in April
- Design for Bergen County Line begun 2/03
- AMTRAK ACSES Compatibility 2003
- Freight/Work Mode 2003



SDU Features

- Graphical & User-friendly
 - ✦ Design/operations team did not want crews to “fly the screen”
- Integrate all User I/O functions:
 - ✦ Speedometer
 - ✦ Current *and* Target Speed authority
 - ✦ Distance to go
 - ✦ Alarms & messages
 - ✦ Numerical keypad
- No signal *Aspects*
- Fit existing space in cab cars & MU's

What the “Speed Display Unit” shows

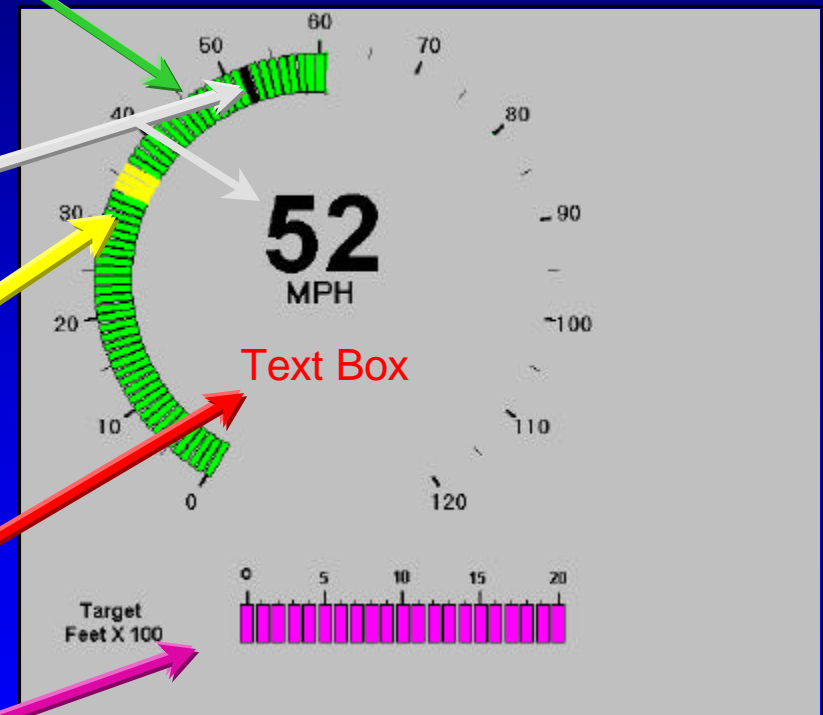
Green band shows maximum authorized speed

Black mark and numerals show current speed

Yellow band is target speed being approached

Red text box displays system messages

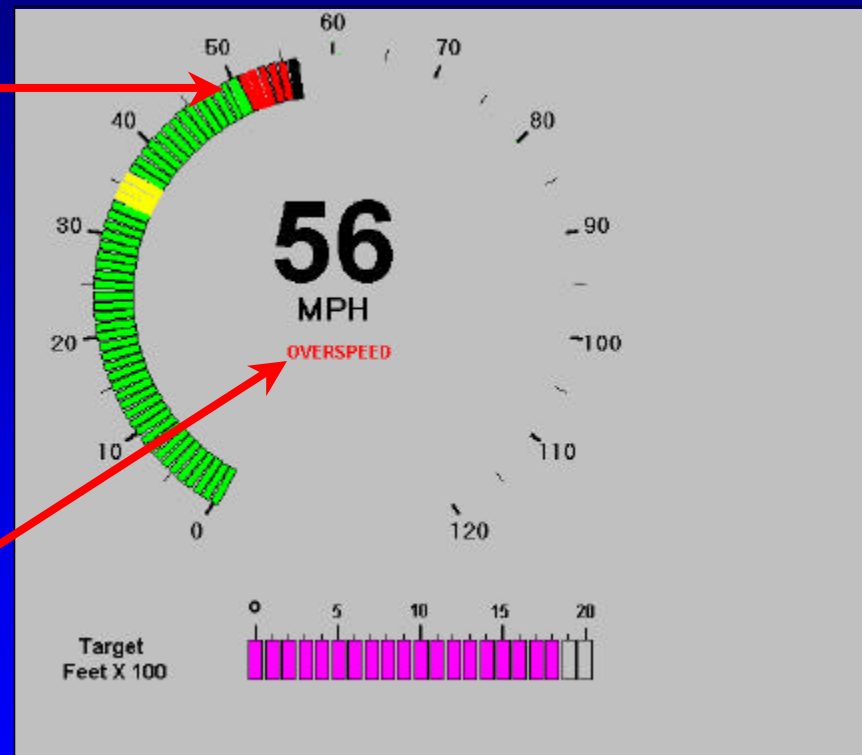
Magenta band shows distance to the target



SDU Overspeed Display

Approaching Target

- **Speed** band will turn **red** above the instantaneous authorized speed calculated from braking profile
- **“Overspeed”** text is displayed
- Sonalert sounds





Questions?

